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AN
ECONOMICAL SYSTEM
OF
Sanitary Drainage
FOR
CITY AND COUNTRY.

BY
M. NADIEIN,

Captain of the Russian Army.

PRICE, 25 CENTS.

Chicago,
World's Columbian Exposition,
1893.

ЭТОТ ТОВАР И ДАВАЕТ

АВТОМАТ ДИ

NEW APPARATUS
FOR
House and City Sanitation
AND
Economical Canalization.

(Patented in Europe and America.)

System of M. NADIEIN, Captain of the Russian Army.

*Chicago,
World's Columbian Exposition,*

1893.

NEW APPARATUS

For the purpose of

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Golden Medal and Great
Honorary Prize,
Hygienic Exposition,
LONDON, 1893.

Honorary Prize,
Universal Exposition,
PARIS, 1893.

Golden Medal and Great
Honorary Prize,
Hygienic Exposition,
BRUSSELS, 1893.

The problem of every drainage system is to carry away, quickly and so far as possible, completely, and in accordance with the laws of hygiene, the refuse and fecal matter from dwelling houses and towns. This problem is most successfully solved by the system explained below, of M. P. Nadiein, which, besides carrying away the filth, renders it possible to ventilate thoroughly the houses, and, moreover, automatically converts the feces without any expense, into manure. The escape of injurious gases from the main sewage into the houses is prevented, on this system, by an apparatus completely isolating the houses from the main sewage. Cess-pools being by this system also entirely dispensed with, there is no possibility of the escape of bad gases into the houses and yards from the putrefying fecal matter lying in these pools. All foul smells arising at the time of removal of fecal matter from the towns are also abolished. This result is obtained in the following manner:

1) The water from waterclosets, kitchens, sinks, urinals, baths etc. is completely separated from the feces before reaching the drainage-system by the automatic action of a separating apparatus, and the intercepted feces are automatically converted, by another apparatus, into manure by being mixed with peat, which is well known to possess disinfectant properties, or with earth, lime, charcoal, or whatever other disinfectant substance shall be suggested by the medical authorities.

2) The apparatus for mixing the feces with peat requires no extra expense in the working, as it is set in motion by the water falling from the separator.

3) Ventilation is produced by the water flowing down the waste-pipe into the sewers, or where there are no sewers, into the pits. This system can be introduced into any house or town

without any change in the building. Another important advantage of the system is the possibility which it gives of burning in ordinary household stoves, in time of epidemic disease, the feces which are well known to carry and spread disease. The dangerous substances are thus completely destroyed by the surest means, fire.

Sanitary Advantages of the system.

Careful observations and calculations have proved that in houses in which water is laid on, the average daily use of water is lb. 330 for each person, while the amount of urine passed by each person averages lb. 2,2 daily and the amount of feces 7 oz.

Sewage water has been shown by experiments to contain, on the average, 1 part of urine to 300 parts of water. Taking into consideration the fact that urine contains 95 per cent. of water we can safely say that if urine be thoroughly mixed with water it can be without danger discharged into the river, even in an unfiltered condition. Moreover, the alternate syphons of the Nadiein system provide for the purification of the mixed water and urine by passing air through it before its admission into the sewer; and, further, the water, before being admitted into the main or pit, can be passed through a filter of peat, which renders effluent water quite harmless.

By the ordinary water carriage system the water flowing from closets and urinals into the drain pipes is always fouled by fecal matter, and contracts a bad smell, because it remains for some time together with fecal matter in the water traps under the water-closets. The water in the traps under the closets is thus artificially polluted and this is increased by the conic form of the closet pans, because the water trickles down the edges of the pan, instead of falling upon the floating excreta which thus remain in the trap until they become liquified. The water from the traps then infects all other water entering the drains from the other reservoirs of the houses.

Nevertheless, it is impossible to avoid these traps, as it is only by means of them that the dwelling houses can be protected from the foul sewer gases, moreover, the traps cause the liquification of excreta, an absolute necessity with the ordinary system, as otherwise the sewers become clogged with accumulations of feces.

By the Nadiein system, traps under water-closets are quite unnecessary, and can be entirely dispensed, with the above mentioned disadvantages being thus avoided. One general trap, placed close to the separating apparatus, is sufficient to prevent the access of air from the chamber in which the apparatus is set up in-

to the house. The liquid refuse from the house in passing through this trap of the separator or the elbow of the waste pipe, forces out from it any excreta which have not already been forced out by the water from the closet; thus all substances valuable for manure are preserved in the solid refuse instead of being dissolved in the water of the trap. The traps under the closets being discarded, the water from the closets falls down the walls of the main waste pipe into the separating apparatus in a nearly pure state, which has been demonstrated by many experiments and investigations. This may be seen from the table given below, which shows the results of the chemical analysis of this water, certified by the chemical laboratory of Dr. Pöehl in St. Petersburg*).

Urinals constructed on the usual system (in houses, barracks, public lavatories etc.) are well known to contract a very disagreeable smell, arising chiefly from the decomposition of the urine. Great efforts have been made to avoid this smell by the use of large quantities of water to flush the urinals. In urinals constructed on the Nadiein system, this difficulty entirely disappears, as the urine falls not into the side of the urinal, but straight into water after which, instead of trickling along the bottom of the urinal, it passes together with the water through a syphon. In case of any urine accidentally falling into the side, it would be washed away by the water, which fills the urinal almost to the top, while rising to the level of the syphon.

All the water, mixed with urine, then flows away through an automatically acting syphon, connected with a special arrangement for sucking air down, while the water is passing. Thus it becomes permeated with the air while passing through the syphon, and the oxygen of the air, combining with the ammonia of the urine, completely decomposes it. As regards the solid excreta, they after being separated from the liquids by the separating apparatus fall into a receptacle where they are covered by a shower of dry peat or some other disinfectant substance, which causes them to lose all their smell. If the manure thus formed is not wanted for agricultural purposes, it can easily be burned in ordinary domestic stoves, as has been shown by practical experience. This is the easier to accomplish as the quantity of dry feces requiring to be burned is small; a house containing 100 inhabitants produces not more than 44—55 pounds per day. By burning the feces all injurious bacteria are, of course, absolutely destroyed. The entire absence of feces, either in the form of solid matter or suspended in the sewage water, greatly diminishes the foul smell of the sewers, and moreover, makes a given area of irrigation land capable of filtering a far greater quantity of sewerage, than with the ordinary water carrying system.

*) See results of Dr. Pöehls analysis P.

By the usual drainage system the entire work of separating the sewer water of the towns from the feces contained in it and filtering the water in order to render it fit for admission into the rivers, is performed by the irrigation fields alone. The solid refuse serves as manure for the fields which are then sown with grass or planted with vegetables. Dr. Pasteur, however, considers that from the point of view of hygiene the tillage of such fields is most objectionable; he advises that such fields be ploughed as often and as deeply as possible, in order to subject them to the purifying influence of atmospheric air. Another disadvantage of the present system of not intercepting the solid from the liquid refuse at once (in the houses) is that the street sewers communicate with the dwelling-houses by means of the waste-pipes, and the gases generated in the main sewers escape into the street-pits, as may be observed by every town-dweller, especially in damp weather. But the bad smell which renders these street-pits a nuisance to the neighborhood in which they are situated, is by no means the only reason why their entire abolition is desirable, there are other, and, hygienically, more important objections to them. When they are cleaned out, the filth from them has access to the streets, and in many cases it comes from hospitals *) in which patients are *suffering from infectious diseases*. The solid refuse often clings into the sides of the sewers and clogs them. On the irrigation fields the solid excreta dry up and form a fine dust which the wind often carries into the towns. It is well known that human excrement is one of the chief means through which epidemic diseases are spread, and it is therefore easy to see how dangerous its admission is, together with water into the sewers. Dr. Brouardel, in his report on the drainage of Paris, says that a system by which the sewers are not entirely isolated from the atmosphere of the town cannot be regarded as satisfactory from a sanitary point of view. The "Comité consultatif d'hygiene" in France, when asked whether a more complete and more convenient system than the present one for the removal of refuse matter is possible, gave the noteworthy answer that "more complete systems are theoretically quite possible and are no doubt realisable". Another body of French specialists, in answer to the same question, said that the solid excreta, which contain both injurious substances and the microbes of disease, *ought not to be admitted to the irrigation fields*.

The Nadiein system renders it possible to fulfil the conditions demanded by these specialists. The separation of the sewer water from the solid refuse, and the conversion of the lat-

*) The excreta of persons suffering from infectious disease should not enter closet-pipes at all. In such cases closets should be replaced by movable vessels containing peat, and all should be at once burned.

ter (by mixing it with disinfectant substances) into fertilizing compost, enables us to remove it quickly and safely; while, on the other hand, the soil and subsoil water are prevented from becoming infected by the sewer water. At the same time the infection of the air by gases from the street-pits is also avoided, as, by the Nadiein system, nothing enters the sewer-pipes from houses but almost clear water, free from all solid or suspended matter and devoid of smell. A smaller quantity of soil is therefore required for irrigation fields, and the soil can be used merely as a filter (as advised by Pasteur), and not for cultivation of vegetables. At present, on the contrary, even those towns which possess a sufficient area of irrigation land for the purpose of filtration will nevertheless be obliged, in course of time, to acquire new lands for that purpose, as the soil, sooner or later, will become saturated, owing to the constant influx of foul sewer water, and will entirely lose its filtering power. On this account, only a certain quantity of sewer water is allowed access to a given area of sewage irrigation land during each year. In Paris the maximum quantity of sewer water allowed for each acre of drainage irrigation lands is 10,500,000 gallons. The result of this is that Paris requires an enormous area of irrigation land. In watering market-gardens with sewer-water, it is necessary to take care that the water should be so spread as to reach only the roots of the plants, as otherwise there is danger of the injurious miasmes being introduced again into the town, together with the vegetable products. But such very careful watering is difficult to arrange on a large scale, and therefore it is necessary to find some other means of securing the irrigation fields against an accumulation of feces; especially as, according to Pasteur, the system at present in vogue, of watering the fields with sewer water containing feces, is entirely out of harmony with the demands of contemporary hygienic science.

Most prominent specialists advise the discharge of sewer water into the sea. If the main sewers be by the sea-shore, the fecal matter would pollute the shore, so that in this case also the separation of the liquid from the solid refuse would be necessary. But the project of discharging sewage water into the sea is accompanied with enormous mechanical difficulties and entails very great expense, and therefore is not practically workable for the great majority of towns.

There remains, therefore, only one way out of the difficulty: to separate the sewage water, while still in the houses, from all solid refuse so completely that the liquids should reach the irrigation fields (and, perhaps, swift-flowing rivers) in the form of clean water, freed from all germs of disease; to subject the intercepted solid matter to such thorough disinfection as to render it innocuous and convert it into valuable compost and then to send this manure

to country places, the soil of which is becoming exhausted and failing to give good crops. The towns should return their refuse to the country.

This is the main condition which has been studied in the invention of the Nadieine system, and it has been so far successfully fulfilled from a technical point of view that the system can be introduced, without any special expenditure or much rebuilding, wherever any of the usual systems for the removal of refuse is in force. Moreover, it fully meets all those demands, both sanitary and economic, with which every rational drainage-system is confronted in our days. Nature, always logical and hygienic, shows us by the example of her creatures, that all animal excreta should be removed; and therefore, in our drainage systems we should not break Nature's law by mixing together solid and liquid refuse, but should separate them on the spot, and not on far off irrigation fields; before reaching it the solid excreta, while in the sewer-pipes or street-pipes, has time to dissolve in and infect the water. As professor Leconte truly says: „It is time for us to leave our old systems; — it is time that such a city as Paris, which counts 2,000,000 inhabitants, should purify the foul air which it breathes, and should at the same time help to increase the fertility of our territory. Those substances which in towns are the sources of disease, should become the sources of agricultural wealth in the country“.

The Economic Advantages of the System.

The water-carriage systems in use at the present time require a great expenditure of water in order to flush both the drains (especially when the excreta are discharged into them) and the water-closets for the purpose not only of the removal, but also of the liquefaction of the feces.

A very large amount of water is also required for the flushing urinals, although as the water usually flows along the bottom of the urinals, their sides are not properly rinsed, the urine decomposes upon the sides, which naturally results in foul smells.

Another economic defect of the present systems is that the value of human excrement as a fertilizing substance is so greatly diminished by the process of washing in water or mixing with enormous quantities of ash which it undergoes that farmers living in the neighbourhood of towns do not find it fit for use, however much they may be in need of manure.

Both these defects, the waste of water and the diminution or

destruction of the fertilizing properties of the feces, are avoided by the Nadieine system. As may be seen from annex account, all the flushing on this system is done by water which has already been used in baths, lavatories, kitchens etc., but which is quite fit to flush closets and urinals, the rinsing out of the closets and urinals with clean water is provided for by reservoirs with syphons acting automatically at regular intervals of time. The pans of the urinals are filled on each occasion almost up to the brim with water, so that their sides are thoroughly flushed.

On leaving the separator, this water sets in motion the automatic apparatus which mixes the dry feces with some disinfectant substance (peat, earth, charcoal, etc.) converting them into a fertilizing compost; still further flowing down the discharge pipe into the drain it draws the air after it, thus ventilating the rooms and urinals, and absorbing the injurious gases accumulated in them; finally it enters the drains (thanks to the special Nadieine syphon) in such quantity and with such force as to thoroughly flush them.

In many municipalities there is an erroneous supposition that the Nadieine system is not capable of adaptation to the sewers already existing in the towns. One of the important advantages of this system consists in its adaptability to all kinds of drains. Moreover, notwithstanding the initial expenditure necessary to fit the houses with separators and other apparatus, the sanitary expenses would certainly decrease during even the first year, owing to the diminution of work in cleaning the drains and other pipes etc.

For instance: 1) Where the water-carriage system discharging excreta into rivers exists, the introduction of the Nadieine system would prevent the pollution of the rivers and their banks, and thus the fecal matter and other anti-hygienic refuse which formerly polluted them and caused mischief, would become productive of good as it could be sold to farmers as a powerful manure.

2) In the case of water-carriage systems connected with sewage-farms there would be no longer any need to acquire enormous areas of land for sewage fields, nor would such fields emit the fearful stench which proceeds from them very often at present. More liquid could be discharged upon each acre of land, and as this liquid would contain a far smaller quantity of organic matter, the earth would filter it more effectually.

3) In case of a cart-carriage system comprising ashpits or middens for fecal matter and any sort of drains for removal of house waters Nadieine system might be of great advantage since it allows to discharge water from the closets, free of solids, also into the drains, while the intercepted fecal matter—to be utilized as a strong fertilising compost.

4) In those towns where there are no underground sewers and where all fecal matter collects in cesspools, it is possible to entirely dispense with these sources of infection and foul smells by using the Nadieine separator. The separated liquid can be then either discharged into small drain-pipes or carried away in ordinary barrels (as it will emit no foul smell), while the antihygienic solid refuse can be removed to a long distance from the town without injuring anyone.

Besides these advantages, the Nadieine system, as explained above, avoids a great evil—communication between the houses and the cesspools or sewers.

5) Where there are no water-closets at all, but only pits or privies, the Nadieine system cannot, of course, be applied, until the unsanitary character of such privies and the need for water laid on and drains of any sort be recognized. Many municipalities object to the construction of sewers only because they fear to pollute the rivers or the soil of the town or of the neighbourhood with fecal refuse from the houses.

For a better proof of the economic advantages of the Nadieine system, we may refer to the data obtained from the actual use of several apparatus during a period of two years.

For a town of 1,000,000 inhabitants and, let us say, 10,000 houses, 30,000 apparatus would be required or an average of three to each house. The cost and instalment of one apparatus, either in the basement, or, when there is no basement, in a pit dug in the ground near the house would average £ 25. Thus, the 30,000 apparatus would cost £ 750,000. The gross income from the sale of 100,000 tons of fertilizing compost, at the rate of £ 2.00 per ton amounts to £ 200,000.

The cost of using the apparatus during the year averages:

1) 740 workmen in constant employment, to fill the hoppers with peat, carry away the refuse, clean out the receptacles and keep the apparatus in repair, counting the average wages per man per week	£ 1,—£ 38,480
2) Peat for the hoppers 85.000 tons of fæces require 15,000 tons of dry peat. This, at 30 per ton, amounts to	£ 22,500
3) Carriage of peat to the houses	3,200
4) Carriage of fertilizing compost from the houses to railway stations, landing-stages etc.	10,000
5) Carriage of fertilizing compost to the villages where a mean distance of 100 miles	14,500
6) 6 per cent annual interest and sinking of the principal capital within 20 years	44,320
7) Expenses of administration	10,000
Total annual expenditure	£ 143,000

The average quality of fertilizing compost obtained has been determined in the laboratory of the Riga Polytechnicum. Mr. Toms, professor of Agricultural Chemistry, after subjecting it to analysis, wrote as follows:

Experimental and Controlling Chemical Laboratory,

Polytechnicum, Riga,

No. 207, 16, I, 1891.

"To Mr. M. Nadieine, St. Petersburg,

Dear Sir:

The analysis of the compost brought to us at your request on Dec. 22, 1890 by Professor Arnold, has given the following results:

The compost contains:

	Percentage in original substance.	Percentage in dry substance.	Percentage in ash.
Dry substance,	21,05	—	—
Ash,	1,69	8,04	—
Ammonia,	0,14	0,66	—
Nitrogen,	1,18	5,63	—
Phosphoric Acid,	0,44	2,09	26,01
Potash,	0,13	0,63	7,82

Professor Toms,

Manager".

Chemical Laboratory of Mr. Poehl, Doctor of Chemistry at St. Petersburg. Vassillievsky Ostrov, 7th line, No 18.

To M. P. NADIEIN, Esq.

Results of analysis of four samples of water.

In 100,000 parts of water.	No. 1*		No. 2*		No. 3*		Water from r. Neva.	
	13/ _V	19/ _{VII}	13/ _V	19/ _{VII}	13/ _V	19/ _{VII}	13/ _V	19/ _{VII}
Reaction	N	e	u	t	r	a	l.	
Smell	fecal smell	no smell	fecal smell	no smell	no smell	no smell	no smell	no smell
Organic matter in the water trap..	45,89	17,40	50,64	17,40	16,93	16,84	13,45	9,49
Amount of oxy- gen necessary for oxidation ...	2,29	0,87	2,53	0,87	0,85	0,84	0,67	0,48
Ditto of Perman- ganate of potash	9,18	3,48	10,13	3,48	3,39	3,37	2,69	1,89
Ammonia.	0,1	0,001 less	0,1	0,001	0,01	0,01	none	none

*) Samples No's. 1 and 2 are taken from the water trap, under the closet pan; No. 3 has passed the „separator”.

C E R T I F I C A T E.

"This is to certify that the separating apparatus of Captain M. Nadiein has been in constant use in the barracks of the Petrovsky fire-brigade company in St. Petersburg, since August 10, 1893.

This apparatus separates waste water from the fecal matter contained in it. The fecal matter is then automatically covered with peat and converted into an almost dry compost, devoid of smell, I certify this as delegate of the St. Petersburg municipal council.

Signed (in the original)

N. Benois, member of the council.

N. Bader, Secretary.

24 June, 1889.

This copy was given out at the request of Captain Nadieine, by the Commission of the Municipal Council and was confirmed on July 19.

N. Benois.

N. Bader."

C E R T I F I C A T E.

*Office of the Prefecture of St. Petersburg, Technical Department,
11 June, 1892. No. 1864.*

"This certificate, given to Capt. Mitrofan Petrovich Nadiein, is to state that his system for the separation of human excrement from house and water-closet waste water has been adopted in several private and public buildings of St. Petersburg.

The system of Capt. Nadiein consists in an arrangement by which the water closet refuse is discharged from the soil-pipe unto a metal surface (1') formed in a parabolic curve, and then separates into solid and liquid, the solids falling (vertically) into a pail, and the water and other liquids (by law of adhesion) trickling over the parabolic surface into a trough from which they pass either into a bucket or unto a wheel and thence to the underground sewers. In this manner the closet water, containing only an insignificant percentage of urine, thoroughly mixed with the water, can be discharged into the sewers, and the solid refuse after being mixed, in the receptacle into which it falls, with peat, earth or charcoal, can be either removed for use as a fertilizing compost, or burned on the spot. Investigations made in the technical department of the Prefecture of St. Petersburg show this system to be worthy of unconditional approval, and therefore its speedy and general adoption is highly desirable.

This I certify with my signature and official seal.

*Major-General von Wahl, of His Majesty's Suite.
Struckof, Chief Engineer".*

C O N C L U S I O N .

We repeat once more that the Nadiein's new principle is capable of application to every sanitation system in use at the present time water carriage system including and is valuable as perfecting and completing each of them. Towns which have no arrangements for the discharge of refuse into the rivers or unto sewage farms, can introduce in connection with this system inexpensive underground pipes. The house refuse and closet water freed from all solid fecal matter and kitchen refuse, before being discharged into the rivers and canals, can be filtered, outside the towns, through a layer of earth, which should be often ploughed but on no account used for cultivation of vegetables. All clogging of the pipes will be avoided, as the water discharged into them will contain no solid refuse. This of course, can be achieved only if the streets are paved and no sand or solid sweepings are allowed to enter street-pits.

The street-pits should be situated above the level of the sewer pipes, and a separating apparatus should be placed in each pit. The boxes into which the solid matter falls should be taken out of the pits every day, and it is well to mix their contents with peat or ash, which at once protect the fecal matter from decomposition and facilitate its removal to country places.

In order that no water may remain in the boxes, and that the solid refuse may be as dry as possible, the boxes should contain syphons constructed upon the intermittent of Nadiein system.

The apparatus described above will greatly improve the sanitary conditions of towns and houses, by avoiding the mixing together of foul and clean matter,—of excrement and water.

The installation of expensive drainage systems in the town the discharge of refuse into the rivers, into irrigation fields or into cess-pools or even into covered buckets or pails are far from being satisfactory from a hygienic point of view. The present drainage systems do no more than merely transference the refuse outside the town, or collect it near the houses in reservoirs dug out in the ground. Better hygienic conditions of a town do not mean that the refuse passes through brick or cement pipes. All injurious refuse should be taken not to fields close to the town, but to far off country fields where it will be gladly accepted as manure and well paid for. A part of the cost incurred by house holders in the towns, in setting up the Nadieine apparatus in their houses, is thus refunded.

The fields directly surrounding towns should not be used for growing either fodder or vegetables, as, in consequence of the superfluity of manure, they are not very useful, and, indeed, are inju-

rious, as food for cattle. Towns should be surrounded not with irrigation fields or heaps of decaying refuse, but with parks, groves and flower-gardens, among which should be built convenient and inexpensive villas. The gradual development of various means of communication renders it increasingly easy for people having business in town live in the environs. Every town dweller would prefer spending his holidays in pure country air to spending them in close and crowded restaurants and beer shops. This suggestion should not be regarded as a sentimental fancy; it is one of the demands of reason and hygiene. The municipal authorities are morally bound to provide what is necessary for the health of the population, and the improvement of sanitation is by no means an impossibility. All that is needed is to avoid polluting with refuse the drain-pipes, water and neighborhood. Injurious matter should be, and can be, converted into useful matter and to this end we should leave off the present practice of artificially producing pollution whether in dwelling-houses or in drainage-pipes. One kilogram per head of unsanitary refuse must be separated at once, on the spot, from the waste water, and taken out of the town.

The river is not the right place for refuse. Carry it to the fields which have grown fruitless through years of reckless farming, and from a source of evil and disease it will become productive of wealth and general welfare for the people.

P. S. The inventor will be glad to receive any criticism or comments on the system expounded above.

Address, M. P. Nadiein,

7 Dumskaya, St. Peterburg,

Russia.

